RUTGERS
WINLAB | Wireless Information Network Laboratory

Intersection Simulation

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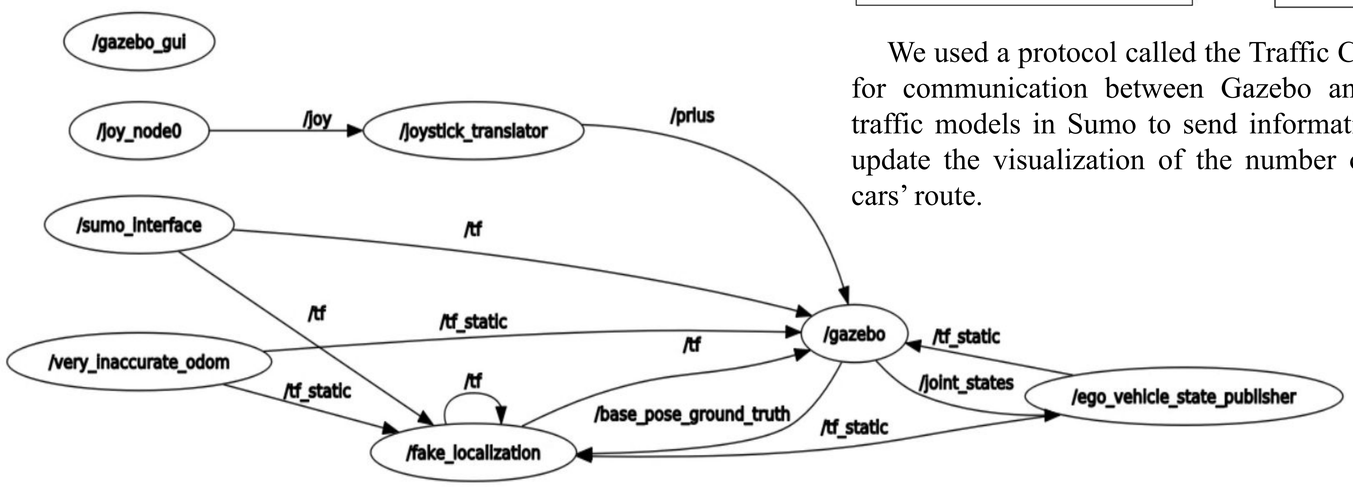
Introduction

Autonomous Vehicles require extensive testing before being made publicly available. Testing such vehicles in actual intersections can be costly and dangerous. Having a simulated environment to test a self-driving system eliminates these concerns while also allowing more freedom throughout testing. In addition, traffic simulators would provide accurate "human drivers" for an autonomous vehicle to train on.

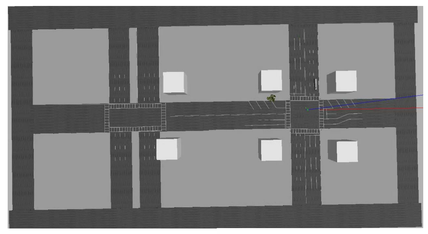
Objective

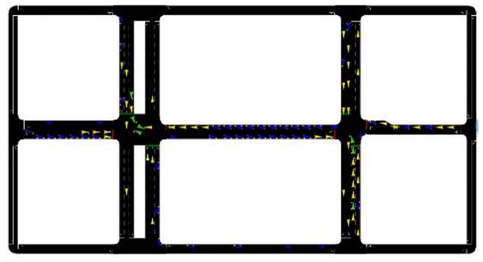
Create a Gazebo simulation of the intersections 120th and Amsterdam Avenue and 120th and Broadway as they are represented in the physical 15:1 scale model at Winlab. This simulation is to be connected to the traffic simulator "Simulation of Urban Mobility" (SUMO). The Gazebo simulation will spawn in cars that are created by the traffic model running in SUMO. The Gazebo simulation should also have a separate car (from SUMO) that is able to take commands from a 3rd party (human driver or self driving model).



Simulation Environment

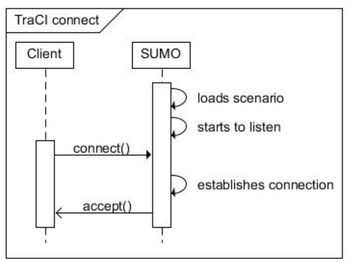
We modeled the intersection (the roads, traffic lights, and street lines) in Gazebo (shown below)

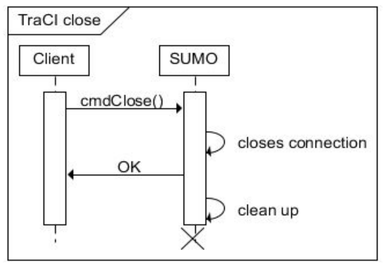




We modeled daily traffic with passenger cars and traffic lights in Sumo (shown above).

Sumo and Gazebo



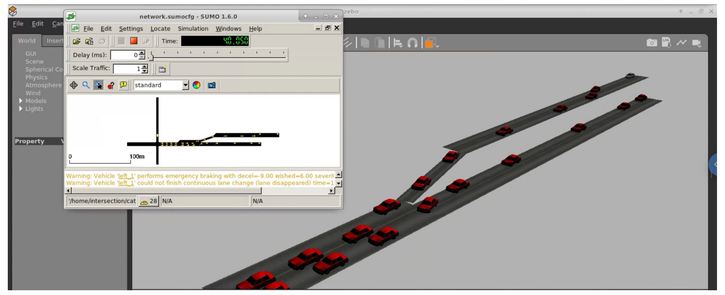


We used a protocol called the Traffic Control Interface (TraCI) for communication between Gazebo and Sumo. This lets the traffic models in Sumo to send information to Gazebo so it can update the visualization of the number of cars running and the cars' route.

Pub/Sub flow chart as mentioned in the ROS section.

ROS

ROS is an operating system used for controlling robots. We used ROS as a publisher/subscriber system for our project. We utilized Mario Garzon's "hybrid simulation" implementation which let SUMO publish the positions of its cars and Gazebo was subscribed to that channel. This alongside TraCI allowed for the traffic model cars in SUMO to spawn in as car models in Gazebo. A flowchart generated by ROS' rqt_graph function is shown in the lower left hand corner of the poster.



Future Work

To continue this project, we would first like to incorporate street parking and pedestrians into our traffic model. These are an integral part of self driving cars, as they are the most common occurrences besides other moving vechicles. We would also like to incorporate the Self-Driving Car from another project into our simulated world. This would let us further push the boundaries of our research.

Acknowledgments

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References

[1] https://hal.inria.fr/hal-01872095/document
[2] https://bitbucket.org/marioney/hybrid_simulation/src/master
[3] https://github.com/osrf/car_demo